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Monte Carlo Methods in Inertial Confinement Fusion

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Monte Carlo methods appropriate to simulate the transport of x-rays, neutrons, ions and electrons in Inertial Confinement Fusion targets are described and analyzed. The Implicit Monte Carlo method of x-ray transport handles symmetry within indirect drive ICF hohlraums well, but can be improved 50X in efficiency by angular biasing the x-rays towards the fuel capsule. Accurate simulation of thermonuclear burn and burn diagnostics involves detailed particle source spectra, charged particle ranges, inflight reaction kinematics, corrections for bulk and thermal Doppler effects and variance reduction to obtain adequate statistics for rare events. Electron transport must be solved simultaneously with self consistent electric and magnetic fields. Inherently nonlinear effects, such as stimulated Compton scattering and collisions between two inflight particles, are particularly difficult to handle by Monte Carlo methods.

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